WHAT IS CLAIMED IS:

1. A medium operable to have at least one frequency band in which both effective permeability and effective permittivity are negative simultaneously, the medium comprising:

a negative permeability medium; and

a negative permittivity medium spatially combined with said negative permeability medium to form the composite medium having a frequency band in which both effective permeability and effective permittivity are negative.

2. The composite left-handed material according to claim 1 wherein elements forming both the negative permittivity composite medium and the negative permeability composite medium are superconducting.

3. The medium of claim 1, wherein both the effective permittivity and the effective permeability have the value –1 at some frequency.

4. The medium of claim 1, wherein said negative permittivity medium comprises a composite medium of elements which collectively exhibit a negative permittivity over at least one band of frequencies.

5. The medium of claim 1, wherein said negative permeability medium comprises a composite medium of elements which collectively exhibit a negative permeability over at least one band of frequencies.

6. The medium of claim 1, wherein at least a portion of the medium may be modulated.

7. The medium of claim 6, wherein said at least a portion of the medium exhibits a nonlinear modulation response.

8. The medium of claim 7, wherein said at least a portion of the medium responds to an electric field.

9. The medium of claim 6, wherein said at least a portion of the medium is operable to be modulated between a left-handed and right-handed medium.

10. The medium of claim 6, wherein said at least a portion of the medium is operable to be modulated between a propagating and non-propagating medium.

11 The medium of claim 6, wherein said negative permittivity medium comprises a modulable permittivity medium spatially combined with said negative permeability medium, the modulable permittivity medium responding to one or more stimuli to be modulable from within or without between one value of a negative permittivity and another value of a negative permittivity.

Sub 913

12. The medium of claim 11, wherein said left-handed medium transmits a selected band of frequencies at one value of modulable permittivity, and transmits another selected band of frequencies at another value of modulable permittivity.

13. The medium of claim 6, wherein said negative permittivity medium comprises a modulable permittivity medium spatially combined with said negative permeability medium, the modulable permittivity medium responding to one or more stimuli to be modulable from within or without between a negative permittivity and a positive permittivity, to form with the negative permeability, when switched to a positive permittivity, a non-propagating composite medium.

14. The medium of claim 6, wherein said negative permeabiliity medium comprises a modulable permeability medium spatially combined with said negative permittivity medium, the modulable permeability medium responding to one or more stimuli to be modulable from within or without between one value of a negative permeability and another value of negative permeability.

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15. The medim of claim of 14, wherein said left-handed medium transmits a selected band of frequencies at one value of modulable permeability, and transmits another selected band of frequencies at another value of modulable permeability.

17. The medium of claim 6, wherein said negative permeability medium comprises a modulable permeability medium spatially combined with said negative permittivity medium, the modulable permeability medium responding to one or more stimuli to be modulable from within or without between a negative permeability and a positive permeability, to form with the negative permittivity medium, when switched to a positive permeability, a non-propagating composite medium.

18. The medium of claim 6, wherein said medium includes an element to stimulate modulation of said permittivity medium from within.

19. The medium of claim 6, wherein said medium includes an element to stimulate modulation of said permeability medium from within.

20. The medium of claim 6, wherein said modulation comprises modulation of said permittivity medium and said permittivity medium modulates in response to an external stimulus.

21. The medium of claim 6, wherein said modulation comprises modulation of said permeability medium and said permeability medium modulates in response to an external stimulus.

22. The medium of claim 1, wherein said negative permittivity medium comprises a gas plasma which may be modulated.

23. The medium of claim 1, wherein said negative permeability medium comprises an antiferromagnetic resonant medium.

24. A left handed composite medium having a frequency band in which both effective permeability and effective permittivity are negative simultaneously, the left handed composite medium comprising:

a supporting substrate;

an array of elements each of which contributes with other elements to form a negative permeability composite medium having a negative permeability over a band of frequencies in said frequency band; and

an array of elements arranged, with said negative permittivity composite medium by said substrate, each of said elements contributing with other elements to form an composite medium having a negative permittivity composite medium, the combination of said negative permeability composite medium and said negative permittivity composite medium forming a composite effective medium having a negative permittivity and a negative permeability over at least one common band of frequencies.

25. The left handed medium of claim 23, wherein said negative permeability composite medium comprises arrays of solenoidal resonator conductive elements.

26. The left handed medium of claim 23, wherein said negative permeability composite medium comprises arrays of split ring resonator conductive elements.

27. The left handed composite medium of claim 25, wherein each said split ring conductive element comprises a split rectangular conducting resonator.

28. The left handed medium of claim 23, wherein said negative permeability composite medium comprises arrays of "G" conductive elements.

29. The left handed medium of claim 23, wherein said negative permeability composite medium comprises arrays of Swiss roll resonator conductive elements.

30. The left handed medium of claim 23, wherein said negative permeability composite medium comprises arrays of spiral resonator conductive elements.

31. The left handed medium of claim 23, wherein each said negative permittivity composite medium comprises a low resistance conducting path arranged adjacent to a corresponding solenoidal resonator conductive element and perpendicular to the axis of the corresponding solenoidal resonator conductive element.

31 23
32. The left handed medium of claim 24, wherein each said negative permittivity composite medium comprises a conducting wire arranged adjacent to a corresponding solenoidal resonator conductive element and perpendicular to the axis of the corresponding solenoidal resonator conductive element.

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33. The left handed medium of claim 24, wherein each said negative permittivity composite medium comprises a conducting path formed by a confined plasma arranged adjacent to a corresponding solenoidal resonator conductive element and perpendicular to the axis of the corresponding solenoidal resonator conductive element.

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33 23
34. The left-handed composite medium of claim 24, wherein each said negative permittivity composite medium comprises a conducting path formed by a confined plasma arranged adjacent to a corresponding solenoidal resonator conductive element.

34 23
35. The left handed composite medium of claim 24, wherein said substrate comprises a piezoelectric medium.

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36. The left handed composite medium of claim 24, wherein said substrate comprises magnetostrictive medium.

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37. The left handed composite medium of claim 24, further comprising a scattering defect within the composite left-handed medium.

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38. A left handed composite medium having a frequency band in which both effective permeability and effective permittivity are negative simultaneously, the left handed composite medium comprising:

a plurality of adjacent units;

one or more split conductive element resonators disposed in each of said plurality of adjacent units, said split conductive element resonators being formed from two concentric conductive elements of thin metal sheets with a gap between the two concentric conductive elements and a break in continuity of each of said two conductive elements; and

one or more conducting wires disposed in each of said plurality of adjacent units, each wire parallel to a plane of each of said split conductive element resonators disposed in each of said plurality of adjacent units; wherein

said split conductive element resonators and said conducting wires having a common frequency band over which there is simultaneous negative effective permeability and permittivity.

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38 39. The left handed medium of claim 37, wherein said concentric conductive elements comprise concentric split rectangular elements.

39 40. The left handed medium according to claim 37, wherein said concentric conductive elements comprise concentric split rings.

40 41. The left handed medium according to claim 37, wherein each of said units not on an outer edge of said medium includes two sections of orthogonal substrate, each of said two sections including one of said concentric conductive elements on a surface thereof, and each having an associated conducting wire.

41 42. The left handed medium according to claim 40, wherein multiple concentric conductive elements are linearly arranged in series on each of said two sections of each of said units not on an outer edge of said medium.

42 43. A transmissive medium with reduced reflection of incident electromagnetic radiation, the medium comprising a sheet of:

a composite left handed medium sheet; and

a sheet of a right handed medium of equal thickness to said composite left handed medium sheet and placed in contact with said left handed medium sheet, said right handed medium and said left handed medium having equal impedances, and equal in magnitude but opposite in sign indices-of-refraction.

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43 44. The medium of claim 42, wherein means are introduced that permit the adiabatic absorption along any direction of propagation within said medium.